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**DIAMOND POWER SPECIALTY CORPORATION
DIAMOND MODEL DP-3000 DURA-PORT GAGE**

**Evaluation Report
NETL Project No. B-518
Subtask 4181
SF013-06-16
12 March 1963
by
J. ISINGER**

**NAVAL BOILER AND TURBINE LABORATORY
PHILADELPHIA NAVAL SHIPYARD
PHILADELPHIA 12, PENNA.**



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Tests were conducted on a pressure gauge

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ABSTRACT

A Diamond Power Specialty Corporation "Dura-Port" Gauge, designed to operate at pressures up to 3000 psig, was evaluated to determine its suitability for shipboard service.

The gage was first shock and vibration tested at the Naval Research Laboratory. The gage insert withstood shock and vibration tests without leakage or glass failure; the illuminator and hood assembly required modification to provide adequate shock and vibration resistance.

The gage was installed on the Laboratory's DDG-15 boiler for determination of clarity and angle of visibility. Readability of the gage, requiring reliance on the color-refraction principle, was considered satisfactory while incorporating a better than 100° viewing angle. Optimum discernment of water level was obtained at distances ten to fifteen feet from the gage.

A 256-hour full pressure test, with blowdown every forty-eight hours and a rapid pressure drop and rise every twenty-four hours, was conducted ~~on the laboratory's water gage test facility~~ without steam leakage or mica or glass failure of the main insert. The shut-off valves showed no leakage at hand tightness during and after cooling. The leakage through the closed ball check was excessive with an average of approximately 1000 cc every 3 minutes and 10 seconds.

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SUMMARY PAGE

The Problem

Evaluate a Diamond Model DP-3000, Dura-Port Water Gauge for naval service on 1200 psi boilers. Agenda for testing was to be in accordance with revised specifications MIL-G-16356B of 25 September 1961, paragraphs 4.2 through 4.2.7. and 4.5 through 4.5.6, shock and vibration tests were to be in accordance with MIL-S-901 of 19 December 1955, and MIL-S-167 of 20 December 1954, respectively.

Findings

After modifications to the gage, illuminator, and hood the entire assembly successfully withstood shock and vibration tests with the exception of light bulbs which failed during shock tests.

Evaluation of the gage on both an operating boiler and the water gage evaluation facility indicated discernment of water level was good. The gage was reliable and required little or no maintenance during several hundred hours of operation. Performance of water gage assembly valves was satisfactory with the exception that excessive leakage occurred through the closed ball check.

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ADMINISTRATIVE INFORMATION

**This project was authorized by BUSHIPS ltr 9510/1-3
Ser 651D-1450 of 18 October 1961. Costs were chargeable to
Allotment 290/RDT & EN 62.2421, Budget Project 50. This is
a final report of an RDT & E project.**

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REPORT OF INVESTIGATION

DESCRIPTION OF MATERIALS

The ported boiler water gage submitted for evaluation was manufactured by Diamond-Power Specialty Corporation. This gage, designated as a Diamond Model DP-3000 Dura-Port Gauge, included an illuminator and wide angle hood, and was designed and built to operate at pressures up to 3000 psig. This gage was to be an improved design over the Diamond Multi-Port Gauge previously evaluated at the Laboratory under NBTL Project B-379 and found to be unsatisfactory because of glass and mica failures.

Previous dual color gages operating on the refraction principle required direct "head-on" viewing to ascertain correct water level. This was a distinct disadvantage. The subject gage was designed to provide a viewing angle of approximately 100°. Details and description of the Dura-Port gage can be obtained by referring to the drawings and photographs included as Plates 1 to 4 of this report. Information as to maintenance and operation of the gage can be obtained from the Diamond Instruction Manual, Bulletin No. 2572, of November 1961.

PROCEDURE AND RESULTS

Introduction

The Bureau of Ships authorized the Laboratory to evaluate the manufacturer's latest design Dura-Port gage according to requirements of the

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revised specifications MIL-G-16356B. Specified tests included operation on both the high pressure water gage test facility and a Laboratory 1200 psi boiler, and a complete shock and vibration evaluation.

Shock and Vibration Evaluation

Because the weight of the water gage plus its mounting exceeded the limit for the Laboratory's vibration testing machine, the Naval Research Laboratory was authorized by the Laboratory to perform both the vibration and shock tests.

While there was no leakage or glass failure during vibration tests, modifications were required to enable the complete gage assembly to meet requirements. The single expansion loop at the top of the gage was replaced with a double, symmetrical loop arrangement, shortening the radius of the loop, producing a more vibration resistant construction in this area; the sides of the wide angle viewing hood were strengthened; other modifications were made to the gage, illuminator and hood. After incorporation of all modifications, the complete assembly successfully passed the vibration requirements of MIL-STD-167 (Ships) for all frequencies between 0 and 33 cps and in each of the three principal directions of vibration.

The gage proper and the wide angle viewing hood and its lens successfully withstood the shock tests, but the function of

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the illuminator was impaired because its light bulbs failed and the glass lenses cracked and/or broke.

A complete description of the procedure and results of the shock and vibration tests are presented in Appendix I, the Naval Research Laboratory's report on the tests.

Installation on Operating Boiler

After shock and vibration tests, the gage was installed on the Laboratory's DDG-15 boiler for determination of clarity and angle of visibility and simplicity of installation.

Although the sharpest designation of water level was had at distances between ten and fifteen feet of the gage, readability, dependent upon the two-color or light refraction principle, was satisfactory with close ups from four to six feet. Difficulty was experienced while mounting the insert to the already assembled bottom valve; the small metal sealing gasket was dislodged from its position on the surface of the raised face of the valve flange. The result of this was considerable steam leakage and a damaged raised face.

Installation on Water Gage Evaluation Facility

The gage was installed on the Laboratory's high pressure water gage testing facility and subjected to a series of rapid

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pressure drops and rises, blowdowns, and pressures and temperatures and water conditions representative of those encountered in current naval power plants. Operation was conducted for 256 hours at full pressure of 1250 psig with blowdown every 48 hours and a rapid pressure drop and rise every 24 hours. A 1000 hour evaluation of the gage was not completed because of reports of successful operation aboard USS SARATOGA (CVA 60).

The gage illuminator assembly functioned satisfactorily throughout the total operating time. No leaks occurred at the port assemblies, no mica or glass failures occurred, and no maintenance was required. Three light bulb failures occurred. Visibility or discernment of water level was good, with a better than 100° viewing angle on the DDG-15 boiler; the distant views were the best. Some difficulty was encountered in replacing burned out light bulbs due to heat from the main insert and the bulb assembly. Gage valve operation was satisfactory, with no leakage through either the steam, water or drain valves during and after cooling and throughout the securing tests. The ball check rose readily, requiring approximately 58.6 lbs. per hour of escaping saturated steam. The seating ability of the ball check, however, was not satisfactory.

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allowing an average leakage of approximately 1000 cc every three minutes and ten seconds, well above the allowable leakage stated in specification MIL-G-16356B, paragraph 3.12.7.2.

During the initial steam and water shut-off valve hot cycling operation, the handwheel torques required for tight valve closure averaged 20 lb. ft. Further valve cycling produced slight packing leaks that were stopped by tightening the gland follower just enough to prevent leakage. Following the gland tightening, valve cycling operation was resumed and it was disclosed that increased handwheel torques were now required for tight valve closure. Torques up to 40 lb. ft. and 35 lb. ft. were necessary for tight closure and subsequent re-opening, respectively. These torques are above the 15 lb. ft. allowable stated in specification MIL-G-16356B, paragraphs 3.10.2 and 3.10.3.

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CONCLUSIONS

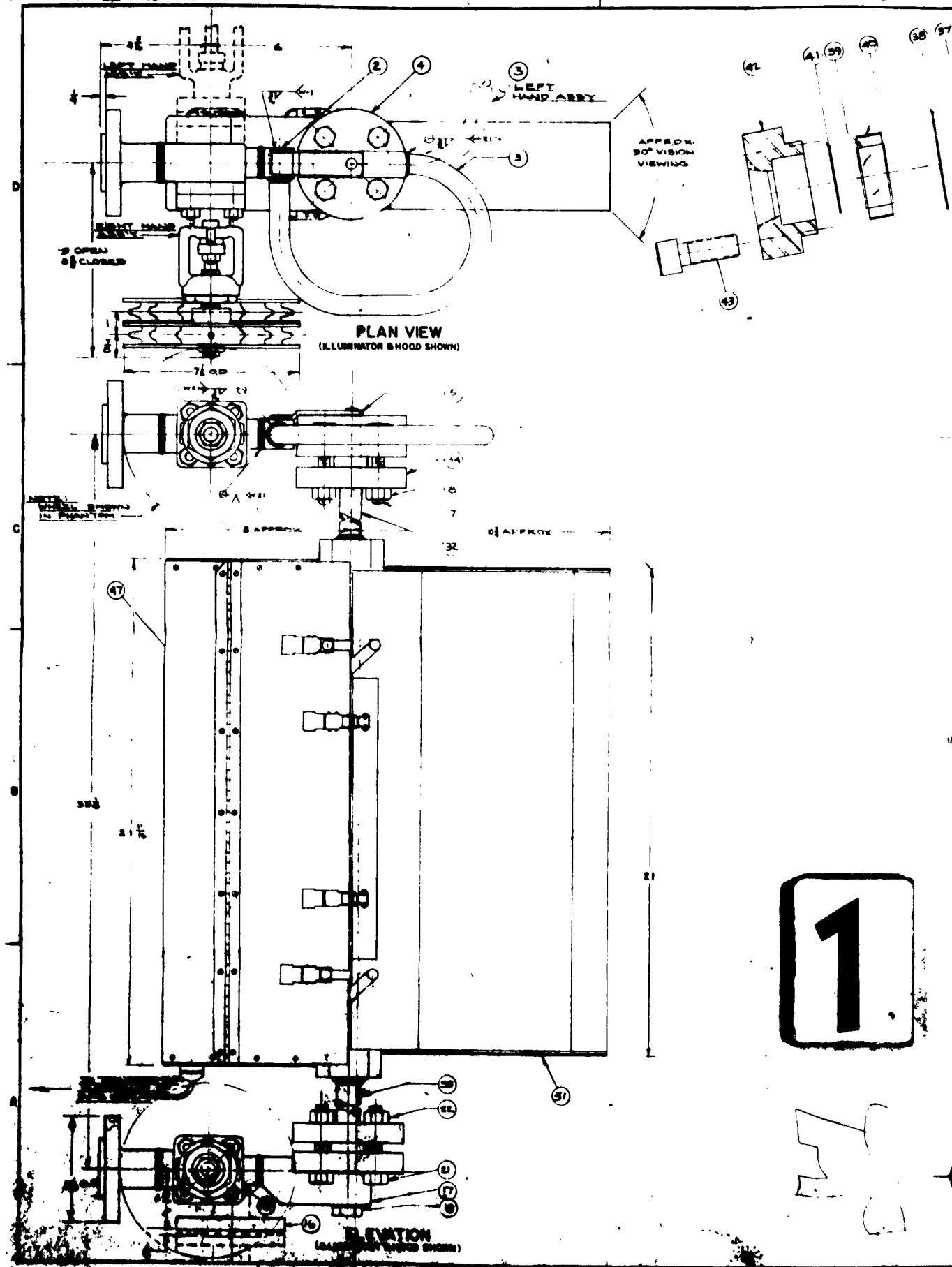
Performance of the gage proper and illuminator during observation and operating test indicated adequate reliability for service use.

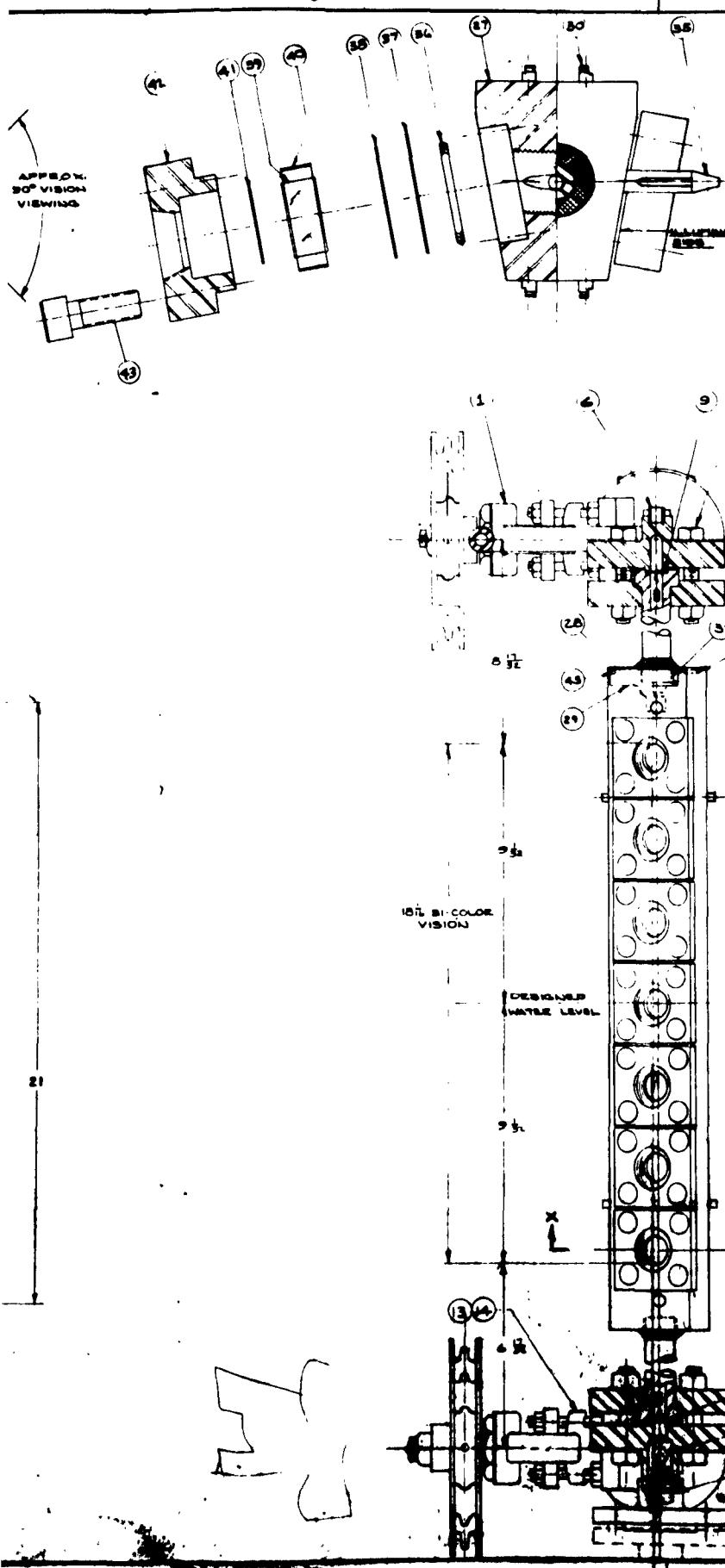
The illuminator, required for proper water level indication, is adequate from a shock and vibration standpoint; determination of clarity and angle of visibility was satisfactory although there is still room for improvement for close up views of four to five feet from the gage.

The main gage insert possessed advantages, namely in its light weight and ease in changing parts; however, care must be used in the assembly of the main insert to the bottom water valve, to avoid dislodging the small sealing gasket.

The ball check valve was closed by 58.6 lbs per hour of escaping saturated steam, which is below the required flow rate. The seating ability of the ball check was unsatisfactory, allowing an average leakage of approximately 1000 cc every three minutes and ten seconds.

Although the shut-off valve operation was satisfactory with no leakage throughout the securing tests, as stated on page 4, it was determined that the handwheel torques required for tight closure and re-opening ranged between 20 and 40 lb. ft.





3 2
LIST OF MATERIAL - QUANTITIES FOR ONE RH. ASS'Y. & ONE

PC. NO.	NAME	NO. QTY	ITEM MATERIAL	MATL. SPEC.	MANUFACTURER'S NAME	ITEM NO.	BUSHING DIA. NO.	UNIT OF MEASURE	STD. SIZE
UPPER VALVE ASSEMBLIES									
1	UPPER VALVE ASSY	1	1 CARBON STL. 102380-0112	102380-0112	102380-0112	102380-0112			
2	CONNECTOR BODY	1	1 CARBON STL. 102380-0114	102380-0114	102380-0114	102380-0114			
3	LOOP - EXPANSION	1	1 CARBON STL. 102380-0115	102380-0115	102380-0115	102380-0115			
4	FLANGE - LOOP	1	1 CARBON STL. 102380-0116	102380-0116	102380-0116	102380-0116			
5	ARM - GUIDE	1	1 CARBON STL. 102380-0118	102380-0118	102380-0118	102380-0118			
6	GUIDE - EXPANSION	1	1 CARBON STL. 102380-0119	102380-0119	102380-0119	102380-0119			
7	1-1/8 HEX HEAD BOLT 3/4-16	4	4 CARBON STL. 102380-0120	102380-0120	102380-0120	102380-0120			
8	1-1/8 HEX NUT	4	4 CARBON STL. 102380-0121	102380-0121	102380-0121	102380-0121			
9	GASKET (OD. 101.7MM)	1	1 CARBON STL. 102380-0001	102380-0001	102380-0001	102380-0001			
10									
11									
12									
LOWER VALVE ASSEMBLIES									
13	LOWER VALVE ASSY (LESS DET.)	1	1 CARBON STL. 102380-0122	102380-0122	102380-0122	102380-0122			
14	UPPER VALVE ASSY (LESS DET.)	1	1 CARBON STL. 102380-0123	102380-0123	102380-0123	102380-0123			
15	1-1/8" FLANGE - SHADOW	1	1 CARBON STL. 102380-0116	102380-0116	102380-0116	102380-0116			
16	FLANGE - SHADOW	1	1 CARBON STL. 102380-0117	102380-0117	102380-0117	102380-0117			
17	CONNECTOR BODY	1	1 CARBON STL. 102380-0118	102380-0118	102380-0118	102380-0118			
18	STAINLESS-STEEL	1	1 STAINLESS STEEL 102380-0119	102380-0119	102380-0119	102380-0119			
19	GASKET (OD. 101.7MM)	1	1 CARBON STL. 102380-0001	102380-0001	102380-0001	102380-0001			
20	3/4 DIA. BALL CHECK	1	1 CARBON STL. 102380-0120	102380-0120	102380-0120	102380-0120			
21	1-1/8 HEX HEAD BOLT 3/4-16	4	4 CARBON STL. 102380-0121	102380-0121	102380-0121	102380-0121			
22	1-1/8 HEX NUT	4	4 CARBON STL. 102380-0122	102380-0122	102380-0122	102380-0122			
23	GASKET (OD. 101.7MM)	1	1 CARBON STL. 102380-0001	102380-0001	102380-0001	102380-0001			
24									
25									
26									
GAUGE ASSEMBLIES									
27	CENTERPLATE	1	1 STAINLESS STEEL 102380-0123	102380-0123	102380-0123	102380-0123			
28	TUBE - BYPASS	1	1 STAINLESS STEEL 102380-0124	102380-0124	102380-0124	102380-0124			
29	INSTRUCTION PLATE	1	1 CARBON STL. 102380-0125	102380-0125	102380-0125	102380-0125			
30	PIN - LATCH	2	2 CARBON STL. 102380-0126	102380-0126	102380-0126	102380-0126			
31	SHIM - END STEM	2	2 CARBON STL. 102380-0127	102380-0127	102380-0127	102380-0127			
32	END STEM UPPER	1	1 STAINLESS STEEL 102380-0128	102380-0128	102380-0128	102380-0128			
33	END STEM LOWER	1	1 STAINLESS STEEL 102380-0129	102380-0129	102380-0129	102380-0129			
34	FLANGE - GAUGE	2	2 CARBON STL. 102380-0130	102380-0130	102380-0130	102380-0130			
35	PIN - SCREEN GUIDE	2	2 CARBON STL. 102380-0131	102380-0131	102380-0131	102380-0131			
36	GASKET - SEALING	14	14 CARBON STL. 102380-0132	102380-0132	102380-0132	102380-0132			
37	GASKET - PROTECTIVE	14	14 CARBON STL. 102380-0133	102380-0133	102380-0133	102380-0133			
38	GASKET - MITAL	14	14 CARBON STL. 102380-0134	102380-0134	102380-0134	102380-0134			
39	GLASS - GAUGE	14	14 GLASS COM. 102380-0135	102380-0135	102380-0135	102380-0135			
40	PACKING STRIP	14	14 ASBESTOS COM. 102380-0136	102380-0136	102380-0136	102380-0136			
41	GASKET - CLAMPTON	14	14 ASBESTOS COM. 102380-0137	102380-0137	102380-0137	102380-0137			
42	COVERPLATE - GAUGE	14	14 CARBON STL. 102380-0138	102380-0138	102380-0138	102380-0138			
43	CAR BLOW - WHISTLE NO.	26	26 CARBON STL. 102380-0139	102380-0139	102380-0139	102380-0139			
44	PLUG - SEAL	4	4 CARBON STL. 102380-0140	102380-0140	102380-0140	102380-0140			
45	FLANGE - GAUGE	8	8 CARBON STL. 102380-0141	102380-0141	102380-0141	102380-0141			
46	FLANGE - GAUGE	8	8 CARBON STL. 102380-0142	102380-0142	102380-0142	102380-0142			
ILLUMINATOR ASSEMBLIES									
47	ILLUMINATOR ASSY	1	1 CARBON STL. 102380-0143	102380-0143	102380-0143	102380-0143			
48									
49									
50									
WIDE ANGLE DIRECT READING HOOD ASSEMBLIES									
51	HOOD ASSY	1	1 CARBON STL. 102380-0147	102380-0147	102380-0147	102380-0147			
52									
53									
DRAIN VALVE ASSEMBLY (THE FOLLOWING DETAILS ARE									
54	DRAIN VALVE PLATE	1	1 CARBON STL. 102380-0148	102380-0148	102380-0148	102380-0148			
55	1500 DRAIN VALVE	2	2 CARBON STL. 102380-0149	102380-0149	102380-0149	102380-0149			
56	PIPE & SCHEDULE 40	1	1 CARBON STL. 102380-0150	102380-0150	102380-0150	102380-0150			
57	SHAMMUS STD. 1015	6	6 CARBON STL. 102380-0151	102380-0151	102380-0151	102380-0151			
58	FLUID	4	4 CARBON STL. 102380-0152	102380-0152	102380-0152	102380-0152			
59	GASKET - CLAMPTON	1	1 CARBON STL. 102380-0153	102380-0153	102380-0153	102380-0153			

ELEVATION
FROM INFRARED ILLUMINATOR &
HOOD ASSEMBLY

2

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REVISIONS

2

LIST OF MATERIAL - QUANTITIES FOR ONE RH ASS'Y & ONE LH ASS'Y

PC NO	NAME	NO REQ GR/T GR2	MATERIAL	MAT'L SPEC	MANUFACTURERS NAME DWG NO	BUSHIPS DWG NO	UNIT	STD NAVY WTLB	STOCK NO	REMARKS
UPPER VALVE ASSEMBLIES										
1	UPPER VALVE ASS'Y	1	CARBON STL	102365-0007	DPSC	10246-0-017				
2	CONNECTOR BODY	1	CARBON STL	MIL-STD-1014	DPSC	10247-0114				
3	LOOP EXPANSION	1	CARBON STL	ASTM A 312	DPSC	102512-0112				
4	FLANGE LONG	1	CARBON STL	MIL-STD-1014	DPSC	102514-0112				
5	ARM-GLIDE	1	CARBON STL	ASTM A 312	DPSC	102538-0113				
6	GUIDE EXPANSION	1	CARBON STL	ASTM A 312	DPSC	102477-0116				
7	1-13 HEX HD BOLT 3 LG	4	4	CARBON STL	MIL-STD-1014	DPSC	102728-1110			
8	1-13 HEX NUT	4	4	CARBON STL	MIL-STD-1014	DPSC	102729-1110			
9	GASKET 100% IDLTH	1	ASBESTOS COML	ASTM A 312	DPSC	924867-0002				
10										
11										
12										

LOWER VALVE ASSEMBLIES

13	LOWER VALVE ASS'Y (EST DATED)	1	SEE ASS'Y DWG	DPSC	102626-1102					
14	LOWER VALVE ASS'Y (EST DATED)	1	SEE ASS'Y DWG	DPSC	102626-1102					
15	2 NIPPLE SHIELD	1	CARBON STL	MIL-STD-1014	DPSC	102593-0116				
16	FLANGE - DRAIN	1	CARBON STL	MIL-STD-1014	DPSC	102592-0117				
17	CONNECTOR BODY	1	CARBON STL	MIL-STD-1014	DPSC	102592-0117				
18	FLANGE - BALL	1	CARBON STL	MIL-STD-1014	DPSC	102593-0117				
19	GASKET 100% IDLTH	1	ASBESTOS COML	MIL-STD-1014	DPSC	924867-0002				
20	2 DIA BALL CHECK	2	STAINLESS STEEL	ASTM A 312	DPSC	102745-0111				
21	1-10 HEX HD BOLT 3 LG	4	4	CARBON STL	MIL-STD-1014	DPSC	102728-1110			
22	1-13 HEX HD NUT	4	4	CARBON STL	MIL-STD-1014	DPSC	102729-1110			
23	GASKET 100% IDLTH	1	ASBESTOS COML	MIL-STD-1014	DPSC	924867-0002				
24										
25										
26										

GAUGE ASSEMBLIES

27	CENTERPLATE	1	STAINLESS STEEL	MIL-STD-1014	DPSC	102477-0114				
28	TUBE-BYPASS	1	STAINLESS STEEL	MIL-STD-1014	DPSC	102480-0114				
29	INSTRUCTION PLATE	1	STAINLESS STEEL	COML	DPSC	102488-0110				
30	PIN-LATCH	2	STAINLESS STEEL	MIL-STD-1014	DPSC	102408-0117				
31	SHIM-CEASST	2	STAINLESS STEEL	MIL-STD-1014	DPSC	102476-0114				
32	BNC STEM UPPER	1	STAINLESS STEEL	MIL-STD-1014	DPSC	102476-0114				
33	BNC STEM LOWER	1	STAINLESS STEEL	MIL-STD-1014	DPSC	102476-0114				
34	FLANGE - GAUGE	2	CARBON STL	MIL-STD-1014	DPSC	102575-0117				
35	PIN SCREEN GUIDE	2	CARBON STL	MIL-STD-1014	DPSC	102449-0116				
36	GASKET SEAL 1/2	14	14	STAINLESS STEEL	MIL-STD-1014	K 5447-0118				
37	GASKET PROTECTIVE	14	14	STAINLESS STEEL	MIL-STD-1014	102449-0119				
38	GASKET MICA	14	14	MICA	MIL-STD-1014	102445-0110				
39	GLASS GAUGE	14	14	GLASS	COML	102444-0111				
40	PACKING STRIP	14	14	ASBESTOS	COML	102443-0112				
41	GASKET - LIGHTING	14	14	ASBESTOS	COML	102442-0113				
42	COVER PLATE GAUGE	4	4	ALUMINUM	MIL-STD-1014	102447-0114				
43	CAP SCREW - SOLID	66	66	CARBON STL	MIL-STD-1014	100511-0112				
44	PLUG - SEAL	4	4	STAINLESS STEEL	MIL-STD-1014	100647-0110				
45	FLANGE - PLATE	2	2	CARBON STL	COML	102401-0034				
46										

ILLUMINATOR ASSEMBLIES

47	ILLUMINATOR ASS'Y	1	1	SEE ASS'Y	SEE ASS'Y	DPSC	102885-1048			
48										
49										
50										

WIDE ANGLE DIRECT READING HOOD ASSEMBLIES

51	HOOD ASS'Y	1	1	SEE ASS'Y	SEE ASS'Y	DPSC	102486-1087			
52										
53										
54										

DRAIN VALVE ASSEMBLY (THE FOLLOWING DETAILS ARE SHIPPED LOOSE)

55	DRAIN VALVE FLANGE	1	1	CARBON STL	MIL-STD-1014	DPSC	102351-0116			
56	1500 DRAIN VALVE	2	2	MARINE MET	COML	3082-U				
57	NIPPLE 1/2 SCHEDULE 40	1	1	CARBON STL	MIL-STD-1014	DPSC	102353-0116			
58	1-100MM STD. PIPE	8	8	CARBON STL	MIL-STD-1014	DPSC	102725-0113			
59	STUD	4	4	ALLOY STL	MIL-STD-1014	DPSC	100647-2110			
60	GASKET - 100% IDLTH	1	1	ASBESTOS	COML	102401-0034				

ZONE/REV	DESCRIPTION	DATA APPROVAL
A	CERTIFIED MODEL CHANGER - DATED 2/2 THREE GAUGES ARE SHIPPED WITH THE ASSEMBLY. THE DIA. OF THE GAUGES IS NOT IDENTIFIED.	4/1 4/1 4/1
B	CERTIFIED MODEL CHANGER - DATED 2/2 THREE GAUGES ARE SHIPPED WITH THE ASSEMBLY. THE DIA. OF THE GAUGES IS NOT IDENTIFIED.	4/1 4/1 4/1

NOTE 1:
THE GAUGE IS USED FOR IN-COCKPIT VISION. THE BIRD
VIEWING SCREEN AND IMAGE IS OBTAINED BY THE
USE OF THE ILLUMINATOR PC-47 SHOWN ON DWG
102887-1082.

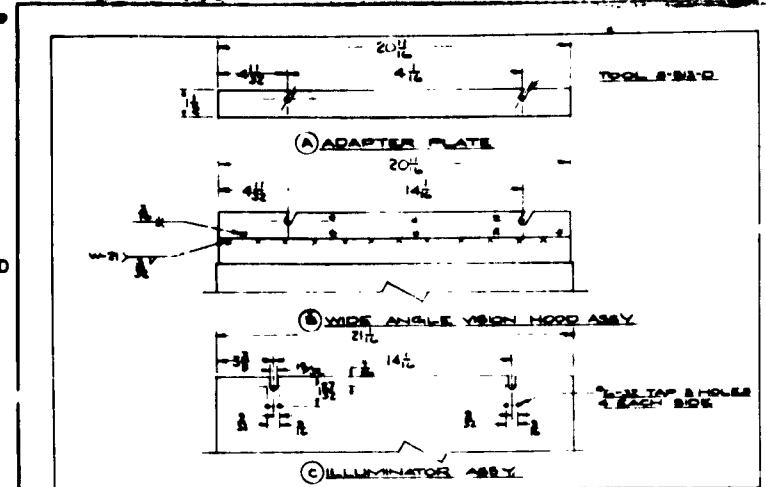
NOTE 2:
TO REMOVE GAUGE FROM VALVE WHILE THE
FLUIDIC LINE IS PRESSURE, CLOSE VALVE, TURN
INWARD ARROWS ON GAUGE STEMS, PULL STEMS
OUT AND REMOVE GAUGE TOWARD OPERATOR.

NOTE 3:
DO NOT HIGHLIGHT MATERIAL OR COMMERCIAL
SPECIFICATION NUMBER. USE THE INDIVIDUAL
ITEM NUMBER LISTED IN TABLE BELOW.

PC NO	MILITARY SPECIFICATION	COMMERCIAL SPECIFICATION
5-1	MIL-STD-890 CL 3	MIL-STD-890 CL 3
5-2		C. F. BAR. STOCK
5-3		
5-4		
5-5		
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LIST OF MATERIAL QUANTITIES FOR

PC NO	NAME	NO REQ	MATERIAL	MAT'L SPEC	MANUFACTURER NAME	MANUFACTURER NO
50	PLATE, SIDE L.H.	1	STEEL	DPSC M10	DPSC	103470-1180
51	PLATE, SIDE R.H.	1	STEEL	DPSC M10	DPSC	103491-1139
52	PLATE, END	2	STEEL	DPSC M10	DPSC	103748-1114
53	STRIPL SPACER	1	STEEL	DPSC M10	DPSC	103771-1114
54	MARK	1	STEEL	DPSC M10	DPSC	103773-1110
55	STRIPL SPACER, NO HOLE	1	STEEL	DPSC M10	DPSC	103774-1110
56	LENS	1	MONALITE	COM L	MONALITE	103775-1113
57	8-32 X 1/2" BAND SCREW	6	STEEL	COM L	BETHLEHEM	645608-0810
58	8-32 NYL NUT	6	STEEL	COM L	BETHLEHEM	645607-0800
59	8-32 NYL WASHER	6	STEEL	COM L	BETHLEHEM	645607-0800
60	LAMP STRIP	2	WIRE CABLE	DPSC M10	DPSC	103774-1111
61	PLATE ADAPTER	2	STRIPL	DPSC M10	DPSC	103670-1108
62						
63						
64						
65						
66						
67						
68						
69						



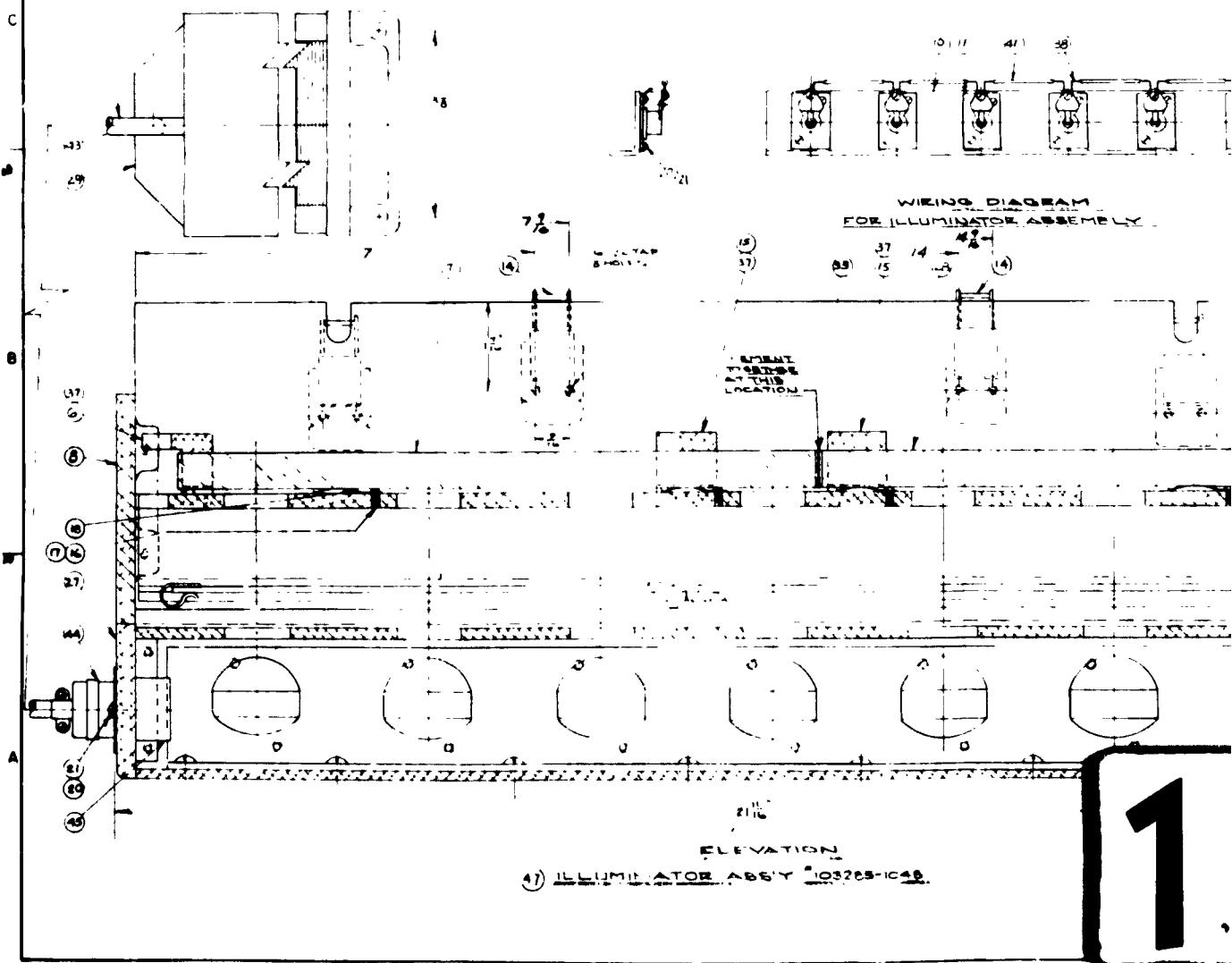
ENCLOSED (A) ADAPTER PLATE ASSEMBLY WAS ATTACHED TO (B) HOOD ASSEMBLY AS SHOWN.
 ENCLOSED (C) ILLUMINATOR ASSEMBLY WAS TAPPED AND BLOTTED AS SHOWN.
 THE ABOVE ASSEMBLIES WERE FURNISHED ON ORDER LW-1291 TEST GAUGES.

10 FT. OF CORD

NOTE:
 LOCATE PLATE ASSEMBLY
 INSIDE ILLUMINATOR ASSEMBLY.

6-82 TAP
4 HOLES

(A) ADAPTER PLATE 103670



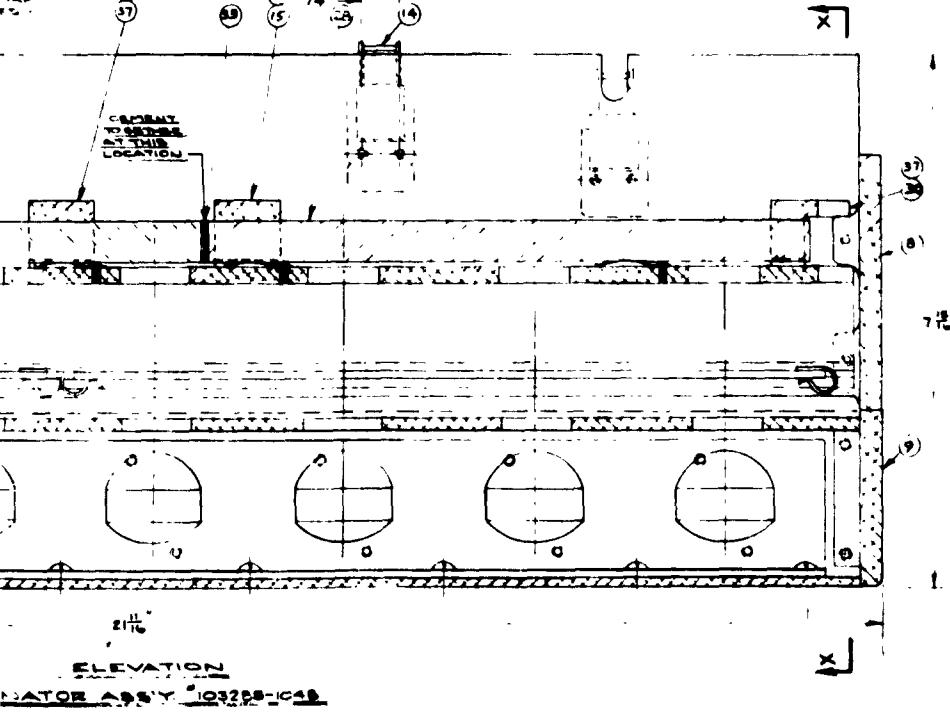
LIST OF MATERIAL QUANTITIES FOR ONE

PC NO	NAME	NO REQD	MATERIAL	MAT'L SPEC	MANUFACTURER NAME	DESIGNATOR	BU SHIPS DWG NO.	WT	STD NAVY STOCK NO	REMARKS
(5) HOOD ASSY 103480-1037 (SEE NOTE -4)										
50	PLATE - SIDE L.H.D.	1	STEEL	DPSC M19	DPSC	103470-110				
51	PLATE - SIDE R.H.D.	1	STEEL	DPSC M19	DPSC	103471-110				
52	PLATE - END	2	STEEL	DPSC M19	DPSC	103740-111				
53	SPRING-SPACER	1	STEEL	DPSC M19	DPSC	103771-111				
54	MARK	1	STEEL	DPSC M19	DPSC	103778-110				
55	SCREWS - SIDE MOUNT	6	STEEL	DPSC M19	DPSC	103628-000				CAP PLATED
56	LENS	1	MONOLITHIC	COML	MONOLITHIC	103772-111				
57	1/4-20 X 1/2" CAP-SCREW	6	STEEL	COML	MONOLITHIC	103600-0010				CAP PLATED
58	1/4-20 HEX NUT	6	STEEL	COML	MONOLITHIC	103601-0000				CAP PLATED
59	1/4-20 LOCKWASHER	6	STEEL	COML	MONOLITHIC	103610-0000				CAP PLATED
60	CLAMP STRIP	2	MONOLITHIC	DPSC M19	DPSC	103774-111				REMADE BY THIS DRAWING
61	PLATE ADAPTOR	2	MONOLITHIC	DPSC M19	DPSC	103670-110				
62										
63										
64										
65										
66										
67										
68										
69										

LIST OF MATERIAL QUANTITIES FOR ONE

PC NO	NAME	NO REQD	MATERIAL	MAT'L SPEC	MANUFACTURER NAME	DESIGNATOR	BU SHIPS DWG NO.
(7) ILLUMINATOR ASSY							
1	BODY - ILLUMINATOR	1	MONOLITHIC	DPSC M19	DPSC	103482-010	
2	LAMP HOUSING	1	MONOLITHIC	DPSC M19	DPSC	103267-010	
3	RETAINER - COLOR SCREEN	1	MONOLITHIC	DPSC M19	DPSC	103268-010	
4	SCREEN-COLOR SCREEN	1	MONOLITHIC	DPSC M19	DPSC	103711-111	
5	SCREEN-COLOR SCREEN	1	MONOLITHIC	DPSC M19	DPSC	103269-011	
6	RETAINER-LENS BOTTOM	1	MONOLITHIC	DPSC M19	DPSC	103610-011	
7	LENS - STEEP	1	MONOLITHIC	DPSC M19	DPSC	103483-011	
8	COVER-ILLUMINATOR	2	MONOLITHIC	DPSC M19	DPSC	103484-011	
9	COVER-TOP	1	MONOLITHIC	DPSC M19	DPSC	103485-011	
10	BRACKET- SOCKET MOUNT	1	MONOLITHIC	DPSC M19	DPSC	103612-011	
11	HOLDER- LAMP	1	MONOLITHIC	DPSC M19	DPSC	103613-011	
12	LAMP- 20 VOLTS 10WATT	1	MONOLITHIC	DPSC M19	DPSC	103266-0000	
13	MINES	1	STEEL	COML	MONOLITHIC	103194-0111	
14	COBBIN CATCH (STEEL)	1	STEEL	COML	MONOLITHIC	103671-0000	
15	RETAINER- LENS	2	MONOLITHIC	DPSC M19	DPSC	103614-0111	
16	1/4-20 DRIVE SCREW TYPE 2	4	STEEL	COML	MONOLITHIC	103601-0140	
17	1/4-20 LOCKWASHER	4	STEEL	COML	MONOLITHIC	103602-0140	
18	SPRING- STRIP LENS	4	STEEL	COML	MONOLITHIC	103615-0117	
19	SPRING- STRIP	1	MONOLITHIC	DPSC M19	DPSC	103616-0117	
20	3/32 INCH-100 SCREW	40	STEEL	COML	MONOLITHIC	103626-0000	
21	LOCKWASHER	40	STEEL	COML	MONOLITHIC	103619-0000	
22							
23	10-24 X 1/2" PAN SCREW	4	STEEL	COML	MONOLITHIC	103646-1022	
24	10-24 X 1/2" PAN SCREW	8	STEEL	COML	MONOLITHIC	103690-1000	
25	10-24 X 1/2" PAN SCREW	16	STEEL	COML	MONOLITHIC	103682-0100	
26	10-24 X 1/2" PAN SCREW	16	STEEL	COML	MONOLITHIC	103683-0116	
27	LENS-BOTTOM (WINGS)	1	MONOLITHIC	DPSC M19	DPSC	103679-0121	
28	LENS- STRIP	1	MONOLITHIC	DPSC M19	DPSC	103645-0118	
29	TRANSFORMER 150WATT	1	MONOLITHIC	DPSC M19	DPSC	103605-0000	
30	RETAINER- LENS - TOP	1	MONOLITHIC	DPSC M19	DPSC	103620-0118	
31	PLATE- 103670-110	1	MONOLITHIC	DPSC M19	DPSC	103610-0118	
32							
33	GASKET	1	MONOLITHIC	DPSC M19	DPSC	103416-0117	
34	SCREEN-COLOR RED 114 LG	1	MONOLITHIC	DPSC M19	DPSC	103711-2123	
35	SCREEN-COLOR- ORANGE	1	MONOLITHIC	DPSC M19	DPSC	103689-0118	
36	CLIP-COLOR SCREEN	1	MONOLITHIC	DPSC M19	DPSC	103695-0118	
37	1/4" ROLL PIN	4	STEEL	COML	MONOLITHIC	103645-0120	
38	COPPER WIRE 14 AWG	1	MONOLITHIC	DPSC M19	DPSC	100159-710	
39	COPPER WIRE 14 AWG	1	MONOLITHIC	DPSC M19	DPSC	100159-1112	
40	TUBING 1/8" 270	1	MONOLITHIC	DPSC M19	DPSC	102810-1113	
41	TUBING 1/8" 270	1	MONOLITHIC	DPSC M19	DPSC	103610-1119	
42							
43	WIRE- 14AWG	1	MONOLITHIC	DPSC M19	DPSC	103685-0019	
44	CONNECTOR- PLUG	1	MONOLITHIC	DPSC M19	DPSC	103374-0010	
45	CONNECTOR- RECEPT	1	MONOLITHIC	DPSC M19	DPSC	103376-0028	
46							
47							
48							
49							

WIRING DIAGRAM
FOR ILLUMINATOR ASSEMBLY

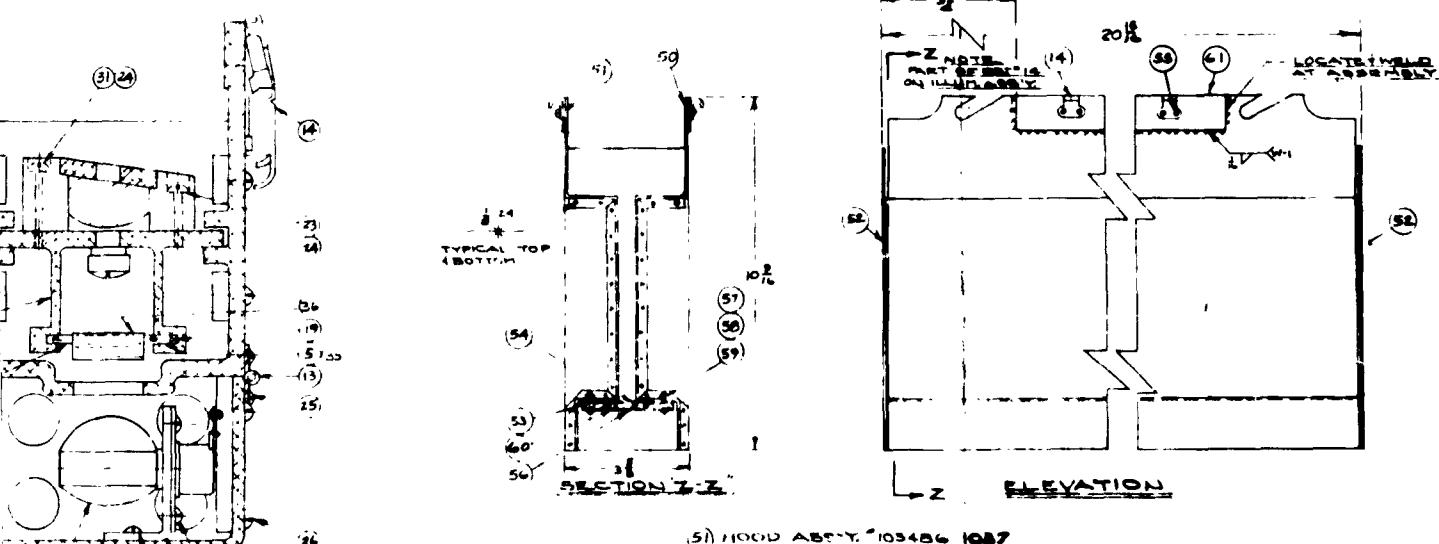


NBTL PROJECT B-518

LIST OF MATERIAL QUANTITIES FOR ONE

PC NO	NAME	NO REQD	MATERIAL	MATL SPEC	MANUFACTURER NAME	TEST NO	SHIP'S DWG NO	WT	STD NAVY STOCK NO	REMARKS	2006 REV	REVISIONS	DESCRIPTION	INSTRUMENTATION
(7) ILLUMINATOR ASSY 103265-1048 (SEE NOTE-1)														
1	BODY - ILLUMINATOR	1	ALUMINUM	ALUM. 103483-010						ELIMINATE ANTIQUE PLATE	A	5	CERTIFIED MODE CHANGED ADDITIONAL ANGLE VISION HOOD ASSEMBLY.	
2	LAMP HOUSING	1	ALUMINUM	ALUM. 103487-010						ELIMINATE ANTIQUE PLATE			ILLUMINATOR ASSEMBLY WAS SHOWN WITH SLOTTED HOLES AS SHOWN IN THE ENCLOSED VIEWS OF THE (1) TEST CALIBERS INVOLVED ADDS TO CALL FOR STANDARD	
3	RETAINER - COLOR SCREEN	1	ALUMINUM	ALUM. 103266-0100										
4	SCREEN - COLOR SCREEN	1	GLASS	COML. 103266-011						FORMULA 7700				
5	SCREEN - COLOR SCREEN	1	GLASS	COML. 103266-011						FORMULA 7700				
6	RETAINER - LENS - BOTTOM	1	STEEL	COML. 103270-010						FORMULA 7700				
7	LENS - STRIP	1	GLASS	COML. 103270-011						FORMULA 7700				
8	COVER - ILLUMINATOR	2	ALUMINUM	ALUM. 103488-010						FORMULA 7700				
9	COVER - TOP	1	ALUMINUM	ALUM. 103270-010						FORMULA 7700				
10	BRACKET - SOCKET MOUNT	1	ALUMINUM	ALUM. 103266-010						FORMULA 7700				
11	HOLD-POLE - LAMP	1	STEEL	COML. 103270-010						FORMULA 7700				
12	LAMP - 10 VOLT 40 WATT	1	GLASS	COML. 103270-010						FORMULA 7700				
13	HINOS	1	STEEL	COML. 103294-0114						FORMULA 7700				
14	COBBIN CATCH (STRIKE)	10	STEEL	COML. 103270-010						FORMULA 7700				
15	RETAINER - LENS	2	ALUMINUM	ALUM. 103270-010						FORMULA 7700				
16	1/4" DRIVE SCREW TYPE	4	STEEL	COML. 103291-0117						FORMULA 7700				
17	10-32 LOCKWRENCH INTERNAL	4	STEEL	COML. 103291-0117						FORMULA 7700				
18	SPRING - STRIP LENS	4	STEEL	COML. 103270-010						FORMULA 7700				
19	SPRING - STRIP	1	PRIMER	COML. 103283-0117						FORMULA 7700				
20	10-32 BOND MACH SCREW	40	STEEL	COML. 103291-010						FORMULA 7700				
21	10-32 BOND MACH SCREW	40	STEEL	COML. 103291-010						FORMULA 7700				
22														
23	10-32 BOND MACH SCREW	4	STEEL	COML. 103291-010						FORMULA 7700				
24	10-32 BOND MACH SCREW	6	STEEL	COML. 103291-010						FORMULA 7700				
25	10-32 BOND MACH SCREW TYPE	6	STEEL	COML. 103291-010						FORMULA 7700				
26	10-32 BOND MACH SCREW	16	STEEL	COML. 103291-010						FORMULA 7700				
27	COVER - BOTTOM (HOUSING)	1	ALUMINUM	ALUM. 103270-010						FORMULA 7700				
28	LENS - STRIP	1	GLASS	COML. 103283-0117						FORMULA 7700				
29	TRANSFORMER - 150 MA	1	COML.	GE. CO. 103200-0000						FORMULA 7700				
30	RETAINER LENS - TOP	1	ALUMINUM	ALUM. 103266-010						FORMULA 7700				
31	10-32 BOND MACH SCREW	1	STEEL	COML. 103291-010						FORMULA 7700				
32														
33	GASKET	1	YARN BKT	COML. 103241-0117										
34	SCREEN - COLOR - ED 1/4 LO	1	RED GLASS	COML. 103271-010										
35	SCREEN - COLOR - GREEN 1/4	1	GREEN GLASS	COML. 103289-0115										
36	CHIP - COLOR SCREEN	1	WHITE GLASS	COML. 103270-010										
37	1/4" ROLL PIN	4	STEEL	COML. 103270-010										
38	COFFEE WIRE 14 SWG	1	COFFEE	COML. 100159-710										
39	COFFEE WIRE 14 SWG	1	COFFEE	COML. 100159-710										
40	TUBING - 1/4" I.D.	2	STAINLESS	COML. 103210-010										
41	TUBING - 1/4" I.D.	2	STAINLESS	COML. 103210-010										
42														
43	WIRE - AWG	10	STAINLESS	COML. 103285-0010										
44	CONNECTOR PLUG	1	STAINLESS	COML. 103274-0010										
45	CONNECTOR - RECEPT	1	STAINLESS	COML. 103274-0010										
46														
47														
48														
49														

48
3.5/10 005 (HOLD)



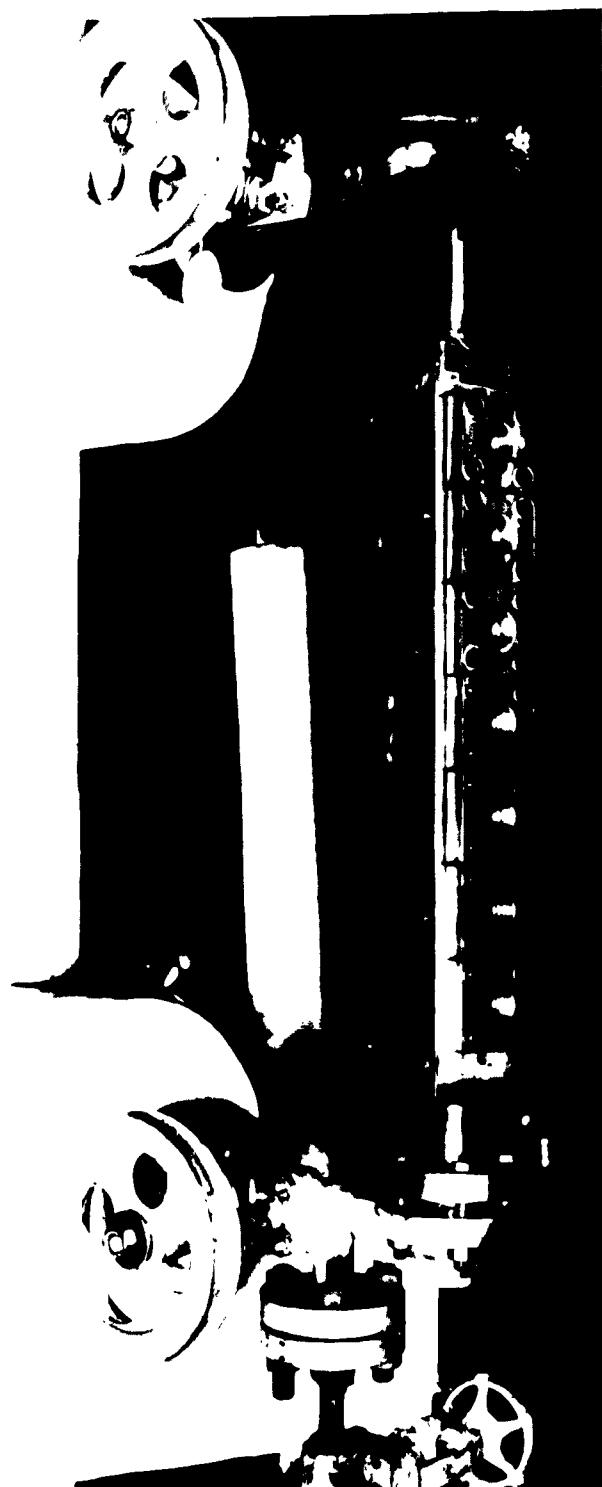
(51) HOOD ASSY 103486-1027

(2) (2) (2) (2)

PAINT SPEC: PAINT INSIDE & OUTSIDE
WITH F24 BULL BLACK

MASTER DRAWING SHEARED BY APPROVED DATE 6-5-61	MASTER DRAWING ILLUMINATOR SWIVEL ANGLE HOOD ASSY. FOR BP-5000 (BURA-PORT) SC. NAVY TYPE GAUGE.	PRINT NUMBER 103265-1048 DRAFT NUMBER 103265-1048
		PLATE 2

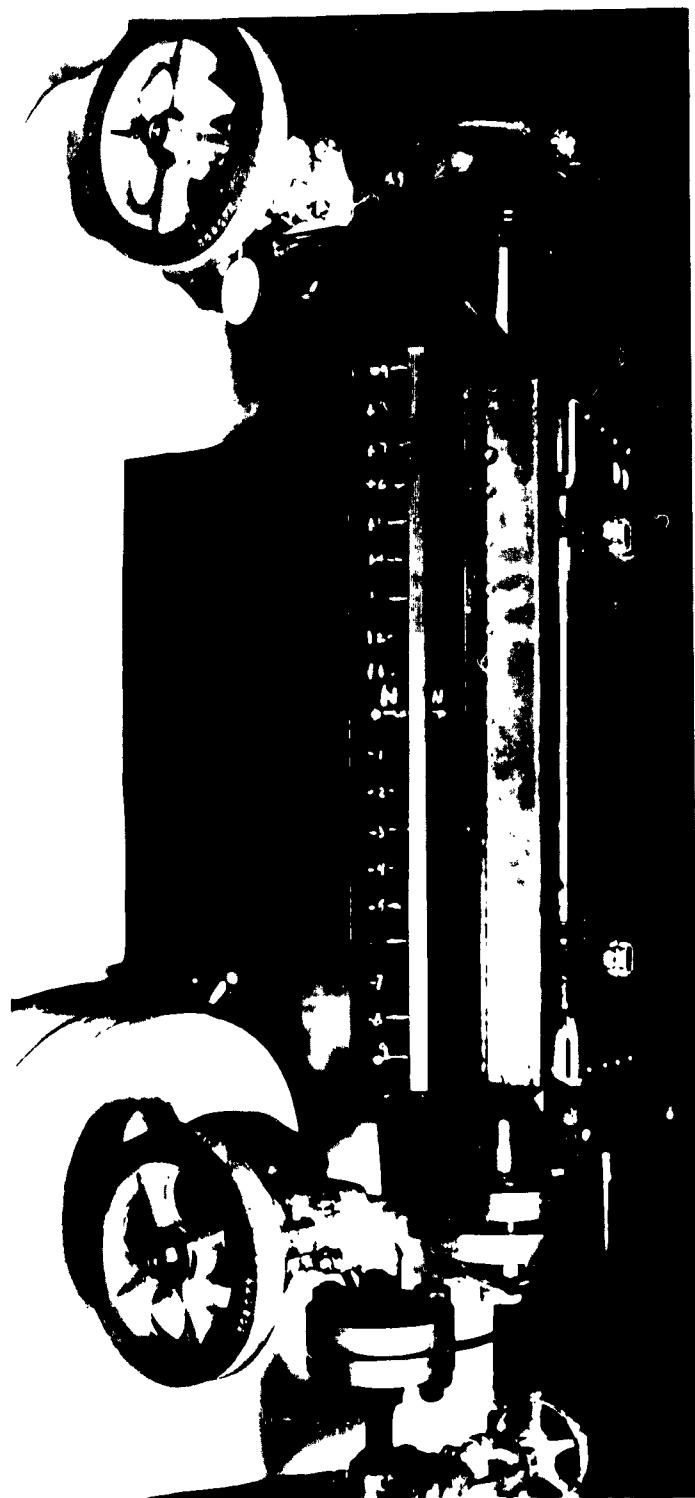
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DIAMOND DURA-PORT WATER GAUGE
MAIN BODY

CHF-979-9-62 (6)

PLATE 3



DIAMOND DURA-PORT WATER GAGE WITH VIEWING
HOOD AND ILLUMINATOR ATTACHED

CSF-979-9-62 (3)

PLATE 4

COPY

U. S. NAVAL RESEARCH LABORATORY
WASHINGTON 25, D. C.

In Reply Refer To.
6253-49A:RCN:dd
NRL Prob F03-15
12 September 1962

Shock and Vibration Folder No. 920

Subj: Dura-Port Boiler Water-Level Gage, vibration and shock testing of; NRL Problem F03-15; report on

Ref: (a) NBTL ltr Code 2722-9510(B-490) (B-518) (B-526) of 2 Feb 1962
(b) Mil Spec MIL-STD-167 of 20 Dec 1954 for vibration
(c) Mil Spec MIL-S-901B(Navy) of 9 Apr 1954 for shock

Fig: (1) Gage assembly, prior to modifications, mounted on the table of a reaction type vibration machine. (The boiler drum nozzles are shown in an intermediate stage of development.)
(2) Gage assembly on vibration machine following modifications and development of boiler drum nozzles.
(3) Sketch of suitable boiler drum nozzles to which gage assembly was secured.
(4) Close-up showing modified upper suspension system for gage.
(5) Gage assembly mounted on vibration machine table for testing in horizontal direction perpendicular to the front.
(6) Gage assembly secured to a 30-degree inclined bulkhead fixture and mounted on the table of a medium-weight high-impact shock machine.

Introduction

1. As requested in reference (a) vibration and shock tests in accordance with references (b) and (c) respectively were conducted on a DP-3000 Dura-Port Boiler Water Level Gauge manufactured by Diamond Power Specialty Corporation of Lancaster, Ohio. This report concludes the vibration and shock work on this phase of the problem.

Encl (1) to NRL ltr
6253-49:RCN:dd
SER: 9818

APPENDIX I

2. The tests were conducted at the U. S. Naval Research Laboratory Washington 25, D. C. during the period 26 February through 16 April 1962 and were witnessed by representatives of the manufacturer, Naval Boiler and Turbine Laboratory, and BUSHIPS.

Description of Unit

3. The gage assembly without the illuminator and wide-angle viewer weighed 175 lb. Its maximum dimensions were: Height 50-1/2 in.; Width 29 in.; Depth 12 in. The aluminum illuminator and steel wide-angle viewer totaled 33 lb. The illuminator was equipped with seven (7) 28-volt, 40 watt reflector type lamps manufactured by Grimes Mfg. Co. of Urbana, Ohio (Grimes part No. 13022). The gage was hydrostatically pressurized to 1500 psig during the variable frequency, and 2-hr endurance vibration tests, and the shock tests.

Vibration Testing Procedure

4. The unit was tested on a reaction-type vibration machine and was subjected to the outlined test procedure separately in each of the 3 mutually perpendicular directions. The test procedure in accordance with reference (b) was as follows:

a. Exploratory Vibration Test. With a table excursion of 0.020 in., an exploratory vibration check was conducted between 5 and 33 cps in discrete frequency intervals of 1 cps at 15 sec per interval.

b. Variable Frequency Test. Vibration was conducted between 5 and 33 cps in discrete frequency intervals of 1 cps at 5 min per interval. The frequency and corresponding table vibratory excursions were as follows: 5-15 cps, 0.060 in.; 16-25 cps, 0.040 in.; and 26-33 cps, 0.020 in.

c. Endurance Test. A 2-hr test in each direction was required at 33 cps or at any resonant frequency below 33 cps, at the appropriate table vibratory excursion outlined in paragraph 4b.

Exploratory Vibration - Horizontal Direction Parallel with the
Front Boiler-Drum Nozzle Development

5. The gage assembly was secured at its mounting flanges to the flanges of a pair of boiler drum nozzles supplied by NBTI. The 1-5/8-in OD x 13/16-in ID steel nozzles were welded to a steel plate which simulated a boiler drum and was secured to a mounting bulkhead on the table of a reaction type vibration machine (Figure 1). With no reinforcing gussets welded to the nozzles the mounted assembly resonated at 14 cps with a TR of 33.5:1 (Transmissibility Ratio is the ratio of the unit's excursion to the vibration table excursion) measured at the gage body. In several stages of development maximum rigidity and the best vibration characteristics of the nozzles were achieved with 4 gussets welded to the nozzles and flanges and steel mounting plate as shown in Figure 2 and delineated in Figure 3. With this arrangement resonance of the gage assembly was observed at 27 cps with a TR of approximately 10:1 measured on the gage.

Development of Gage-Assembly Suspension

6. During the exploratory vibration test the following developmental corrections and modifications were incorporated in the gage assembly to improve its structural and vibration characteristics:

- a) Relative motion between the gage upper and lower valve mounting flanges and the nozzle mounting flanges was eliminated by inserting a ring-type steel spacer between the 2 flanges (Figure 4).
- b) The single-pipe expansion-loop suspension at the upper end of the gage was replaced with a more rigid double-pipe expansion, loop suspension (Figure 4).
- c) Side-to-side relative motion between the upper valve assembly and the upper end of the gage assembly was reduced by a key and keyway block assembly (Figure 4). Clearance between mating parts must be provided at the upper suspension area to allow for thermal expansion.
- d) The suitcase-type latches did not adequately secure the illuminator and wide-angle viewer which were suspended each on four 1/4-in diam. steel pins projecting from the gage. The latches

were removed. The 1/4-in diam. steel pins were each replaced with a 5/16-18NC hex-socket-head cap screw which secured the illuminator and viewer to the gage (Compare Figures 1 and 2).

e) Cracks developed in the viewer around its suspension slots and at the sharp 90-degree bend where it fitted around the gage. The portion of the viewer which was fitted and secured to the gage was reinforced by tack and spot welding a 7/64-in thick formed steel plate to the full length of each side (Figures 2 and 5).

The foregoing corrections and modifications raised resonance above 33 cps and lowered the TR to approximately 6:1 measured at the upper end of the gage body when vibrated in the horizontal direction parallel with the front.

Variable Frequency and Two-Hr Endurance Tests - Horizontal Direction Parallel with the Front

8. The variable frequency test from 5 through 33 cps, and the 2-hr endurance test at 33 cps in accordance with paragraphs 4b and 4c respectively were completed satisfactorily.

Vibration Testing - Vertical Direction

9. No resonances were observed below 33 cps in this direction and the maximum TR of 4.3:1 was measured at the upper end of the gage body at this frequency.

10. The variable frequency test from 5 through 33 cps, and the 2-hr endurance test at 33 cps were conducted without damage or hydraulic leaks.

Vibration Testing - Horizontal Direction Perpendicular to the Front

11. The gage assembly was mounted on the vibration machine table as shown in Figure 5 for testing in this direction. No resonances were observed below 33 cps and the maximum TR of approximately 2:1 was measured at the upper end of the gage.

12. The variable frequency test, 5-33 cps, and the 2-hr endurance test at 33 cps were conducted satisfactorily.

1 Shock Testing Procedure

1 13. The gage and nozzle assembly mounting plate was secured to a 30-degree inclined-bulkhead fixture which was mounted on the table of a mediumweight high-impact shock machine (Figure 6). The gage was pressurized to 1500 psig. during the shock testing procedure.

1 14. With a total of 2925 lb. on the shock machine table the assembly was subjected to a total of 6 Class A shock blows in accordance with reference (c). The shock blows consisted of 2 hammer drops from a height of 1.25 ft with a 3-in table travel, 2 drops from a height of 2.25 ft with a 3-in table travel, and 2 drops from a height of 2.25 ft with a 1-1/2-in table travel. The lamp positions in the illuminator were designated numerically with No. 1 at the top.

1 15. The results of the shock blows were:

1 a. Blow 1. 1.25 ft hammer drop, 3-in table travel.

1 1. The filaments of bulbs Nos. 1, 3, 6, and 7 fractured. New bulbs were inserted. No other damage resulted.

1 b. Blow 2. 1.25-ft hammer drop, 3-in table travel.

1 1. The filaments of bulbs Nos. 2, 6, and 7 fractured. The bulbs were replaced.

1 c. Blow 3. 2.25 ft hammer drop, 3-in table travel.

1 1. The filaments of bulbs Nos. 1, 3, and 6 fractured. No replacements were made.

1 2. A 0.070 in. vertical clearance was measured between the keyblock and keyway block.

1 d. Blow 4. 2.25-ft hammer drop, 3-in table travel.

1. The filaments of bulbs Nos. 4 and 7 failed. The bulbs were not replaced.
2. A clearance of 0.115 in. was measured between the keyblock and the keywayblock.
 - e. Blow 5. 2.25 ft hammer drop, 1-1/2-in table travel.
 1. The filament of bulb No. 5 failed. The bulb was not replaced.
 2. A 7/32-in clearance was measured between the keyblock and keywayblock.
 - f. Blow 6. 2.25-ft hammer drop, 1-1/2-in table travel.
 1. No additional obvious damages resulted from this blow.
16. Following completion of shock testing examination of the interior of the viewer showed the lower strip lens to be fractured at the retaining spring, and the upper strip lens was chipped at its lower support bracket. The progressive increase of clearance between the keyblock and keywayblock resulted from slight deformation of the double-pipe expansion assembly. The use of a dovetail-shaped key and keyway would prevent separation of mating parts. No hydrostatic pressure drop resulted in the gage from the 6 shock blows. Following shock testing the gage was pressurized hydrostatically to 2250 psig for 30 min and no leaks were observed.

Conclusions

17. On the basis of the tests conducted the subject gage is considered satisfactory for vibration and shock conditions as defined by references (b) and (c) respectively subject to compliance with the following recommendations.

Recommendations

18. It is recommended that:
 - a. The gage assembly shall be secured to boiler drum nozzles which are at least as rigid as the modified nozzles developed at NRL and shown in Figures 2 and 3.

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NRL Prob F03-15

b. The modifications and corrections noted in paragraphs 6a through 6e or their equivalent be incorporated in the production model gage assembly.

c. If available, the use of Navy "rough-service" type lamps in the illuminator should be considered.

Report prepared by

/s/ Richard C. Nowak
Richard C. Nowak
Mechanical Engineer

Report approved by

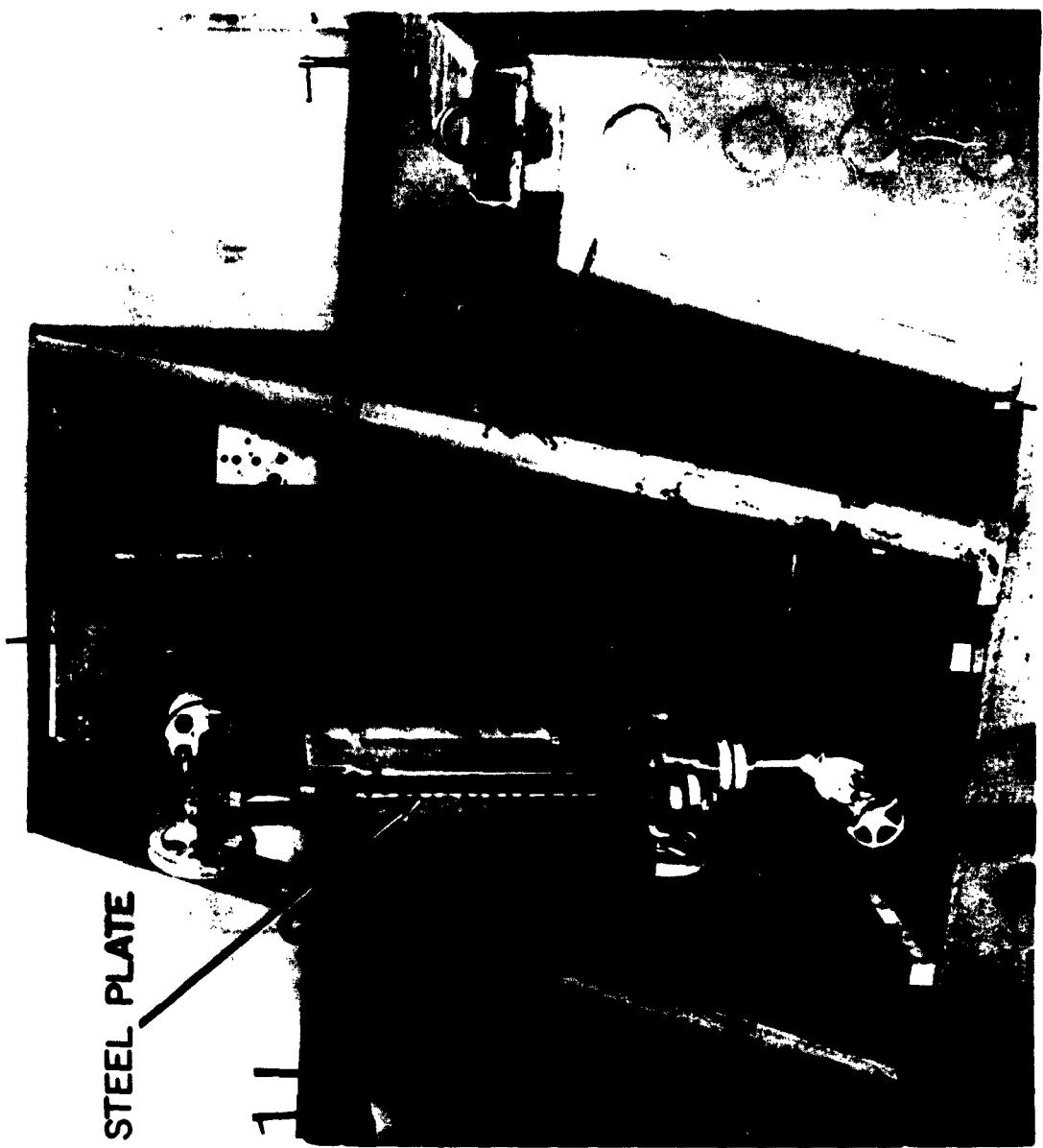
/s/ Harold M. Forkois
Harold M. Forkois
Mechanical Engineer



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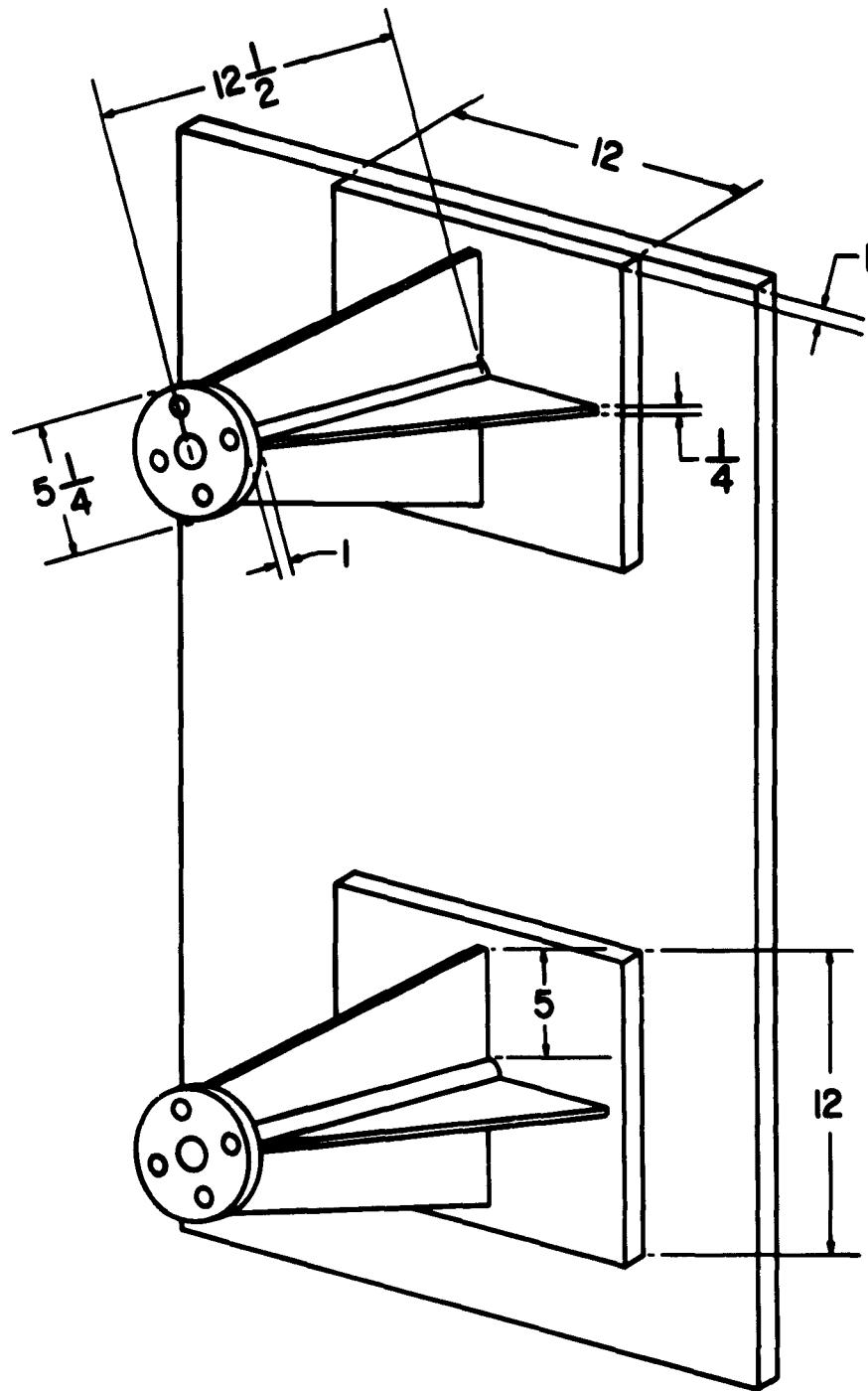
Figure 1



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$$100\% = 100\% \quad (1)$$

Figure 2

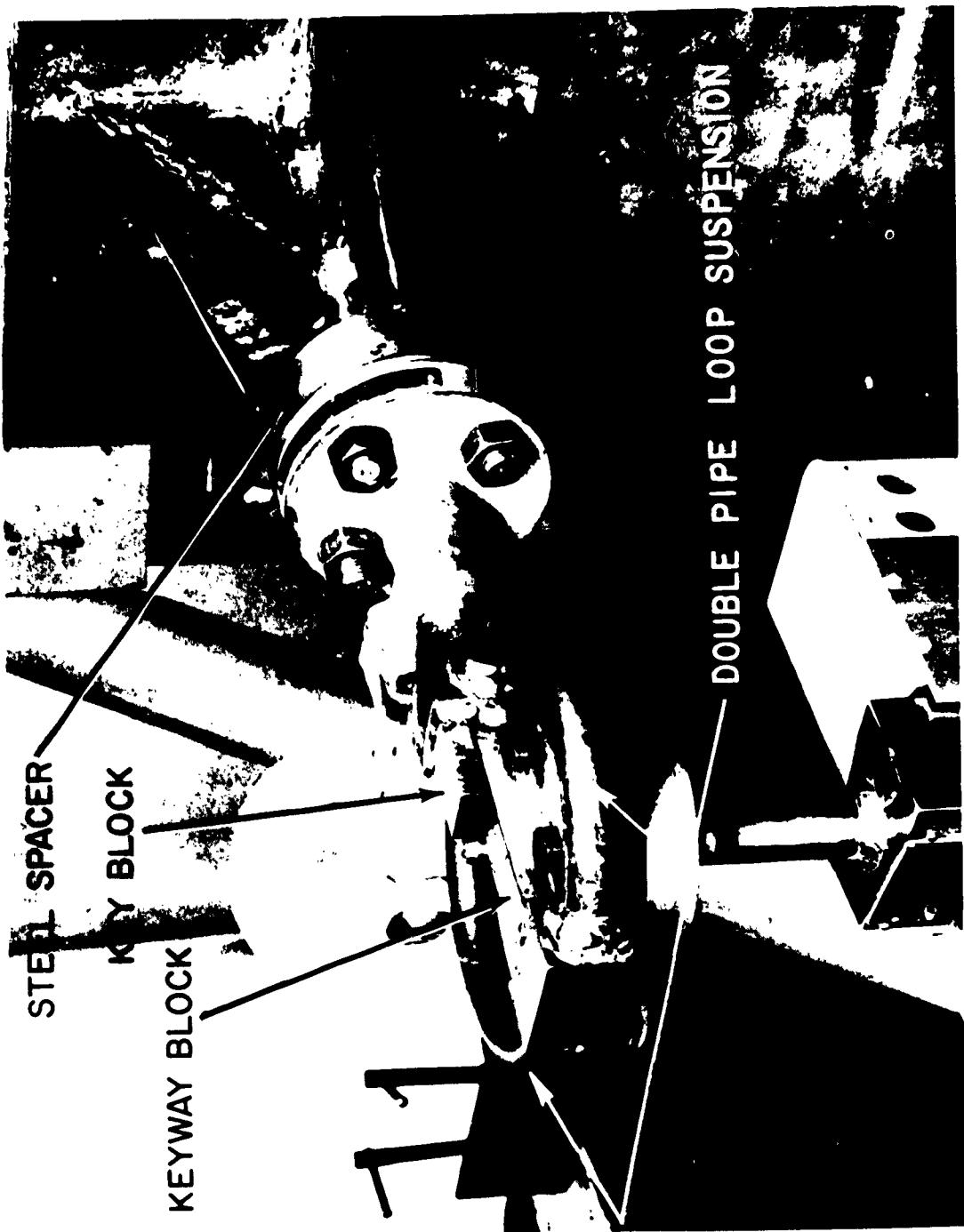


BOILER GAUGE NOZZLE REINFORCEMENT

6253-49A

60-1-63

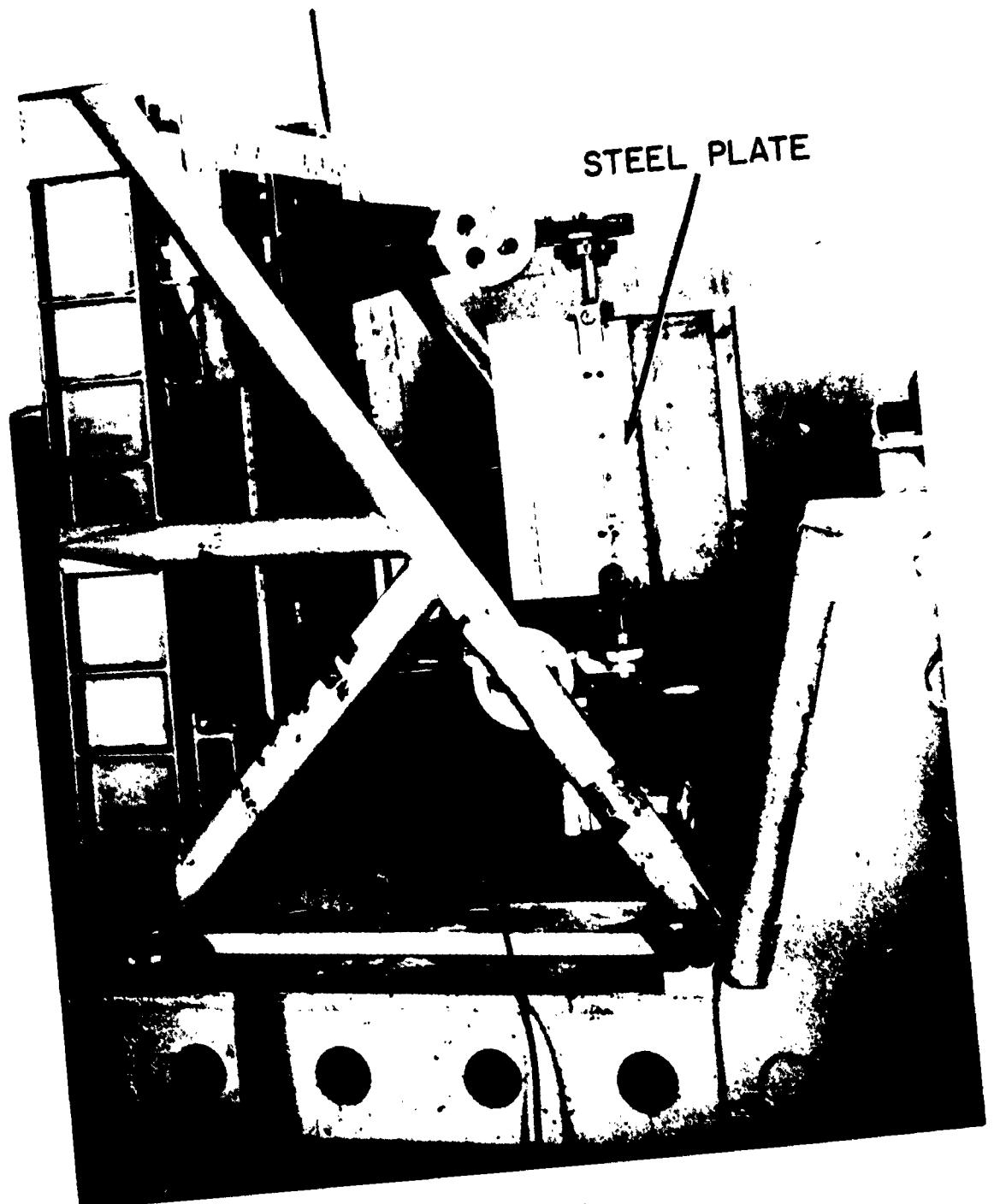
Figure 3



6.253-10A

Exhibit 1 - 1 ()

Figure 4



62 x 3 x 19 N

Figure 5

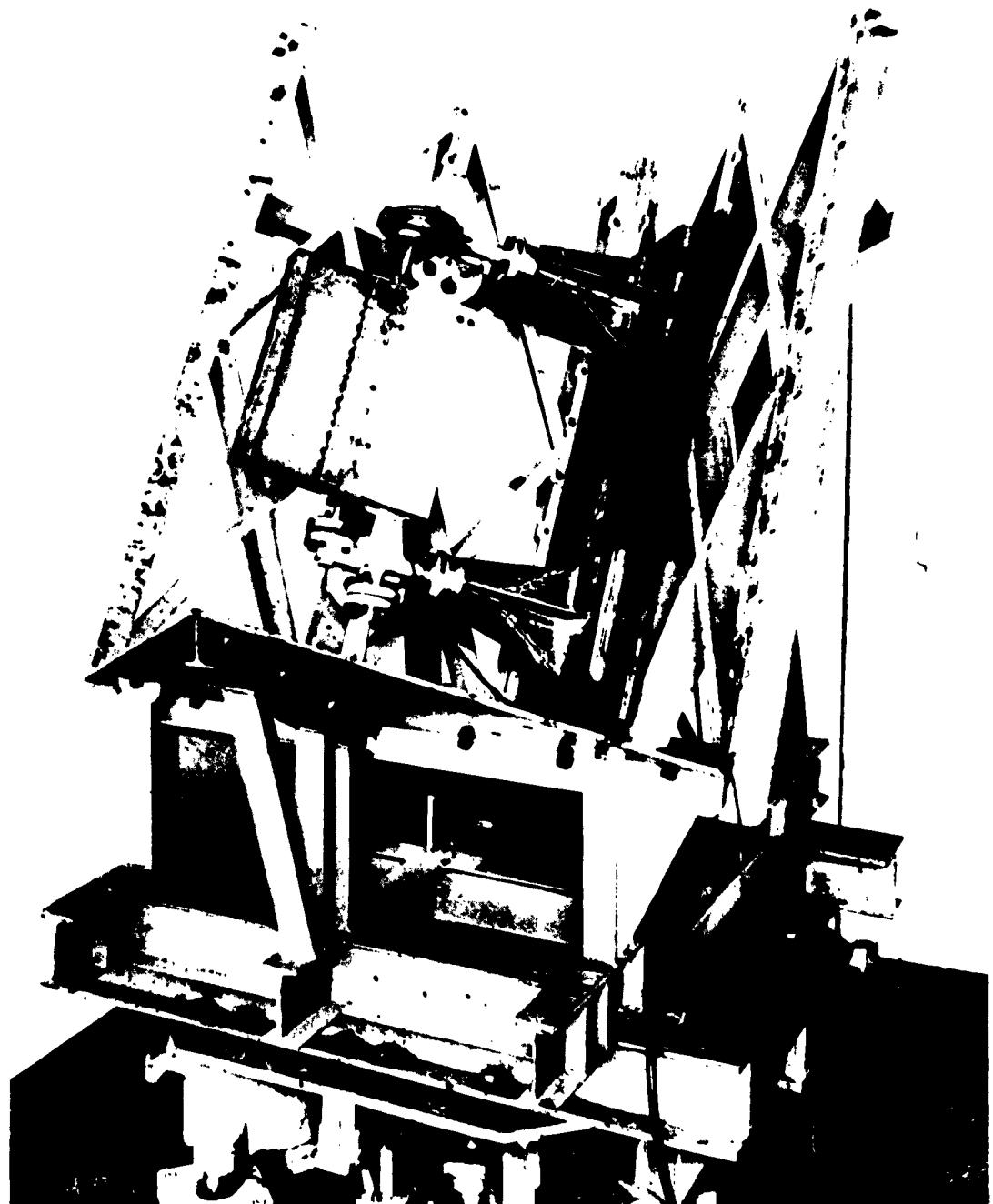


Figure 6

Figure 6

The gage was shock and vibration tested at NRL. The gage insert, withstands shock and vibration tests without leakage or glass failure; the illuminator and hood assembly required modification to provide adequate shock and vibration resistance. Readability of the gage, requiring reliance on the color-refraction principle, was considered satisfactory while incorporating a better than 100° viewing angle. Optimum discernment of water level was obtained at (See other card)

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